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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/736,795	12/14/2000	Michael B. Ball	3817.1US (97-1350.1)	6757

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EXAMINER

PERT, EVAN T

ART UNIT PAPER NUMBER

2829

DATE MAILED: 09/10/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application N .

09/736,795

Applicant(s)

BALL ET AL.

Examin r

Evan Pert

Art Unit

2829

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 08 January 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-4, 6-22, 24, 25 and 28-40 is/are pending in the application.
- 4a) Of the above claim(s) 10-12 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-4, 6-9, 13-22, 24, 25 and 28-40 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Election/Restrictions

1. Claims 10-12 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected species, there being no allowable generic or linking claim (i.e. claim 1, identified as "generic" to Species I by applicant in paper 14, is not allowable). Election of Species II was made **without** traverse in Paper No. 14.

Information Disclosure Statement

2. The examiner acknowledges applicant's submittal of an IDS with the application filed 12-14-2000. However, this IDS referred to by applicant is not located in the paper file at time of this writing. Applicant is advised to submit a duplicate form 1449, in response to this action, for proper initialing by the examiner.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 2, 3, 18 and 28-30 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 2, 3 and 18

The term "substantially equal to a desired height" in claims 2, 3 and 18 (referring to independent claim 1) is a relative term, which renders the claims indefinite.

The term "substantially equal to a desired height" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention.

The indefiniteness of this rejection applies specifically to "molten" material being disposed in the "layer having a thickness equal to a substantially desired height," such as "molten solder."

It is notoriously well known to the ordinary of skill that molten solder takes on a particular shape because of surface tension, wettability and viscosity effects, such that molten solder deposited in openings of a mask appears to have a curved shape:

For example, Fig. 2 of U.S. 4,763,829 shows the result of molten solder being disposed in openings that actually "mold" the shape of the bumps.

For purposes of examination, particularly with respect to "molten material" being disposed in openings, the height of conductive structures 15, 16, 17 in Fig. 2 of '829 is considered as being "substantially equal to the thickness of polymer solder mask layer 14" because the mask "molds" the bumps and makes them high corresponding to the thickness of the mask 14.

Applicant explains in paper no. 12 that one of ordinary skill would know what "substantially equal" means in this case. Yet, since applicant has failed to definitively state what "substantially equal" means, the examiner interprets "substantially equal" as meaning "within +/- 50%":

Based on the dictionary definition of "substantially", the examiner reasons that when a bump height is between 50% and 150% of the mask's thickness, it is reasonable to say "the bump height is substantially equal to the mask thickness."

Claims 28-30

The act of "softening or melting said solder mask material" is required by claims 28-30, yet the specification fails to disclose or direct one of ordinary skill to any solder mask material that is suitable for "softening or melting," rendering the composition of workable solder mask material indefinite.

As understood by the examiner, a notoriously well-known "spin-on" photo-resist is not "melted or softened" because it is a chemical liquid that is cured after application.

What material is "softened or melted," and then acts as a suitable mask that "defines the height of conductive structures deposited through openings in the solder mask"? Is such a material known by way of other references?

Applicant should provide the appropriate reference(s) detailing a polymer known at the time of filing that is "softened or melted", and is suitable for practicing the invention.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claims 1, 6, 8-11, 13-17, 19-22, 24-25 and 31-40 are rejected under 35 U.S.C. 102(b) as being anticipated by Lin et al. (U.S. 5,587,342).

Regarding claim 1, Lin et al. disclose a method of disposing a conductive structure on at least one contact pad on an active surface of a semiconductor device substrate (i.e. pad 12), comprising: disposing a layer comprising polymeric material over the substrate (i.e. polymeric photoresist layer 15); imparting said layer with a thickness substantially equal to a desired height of the conductive structure (col. 3, lines 2-4 taken with embodiment described for Fig. 6); forming at least one aperture through said layer to expose at least a portion of the at least one contact pad [i.e. "holes or vias 20"]; disposing a quantity of conductive material on said layer and permitting said conductive material to substantially fill said at least one aperture [Fig. 3]; bonding said conductive material within said aperture to the at least one contact pad to form the conductive structure of substantially said desired height [col. 4, lines 16-20]; and at least partially exposing a lateral periphery of the conductive structure through said layer [i.e. removing polymer 15 exposes a lateral periphery of conductive structures 30].

Regarding claim 6, Lin et al. discloses that disposing the polymer (photoresist) layer comprises placing a quantity of polymeric material (photoresist) on the substrate and wherein said imparting comprises spreading said polymeric material to a substantially consistent thickness over at least a portion of a surface of the substrate [col. 2, line 44 to col. 3, line 13].

Regarding claim 8, Lin et al. discloses that forming the aperture comprises etching said aperture through the polymeric layer [col. 5, lines 4-6 wherein "patterned" includes "etched" since "etching" is taken to mean "removing by mechanical and/or chemical means.")].

Regarding claim 9, Lin et al. discloses that etching occurs following said disposing said layer over the substrate (since the etching patterning of the spin-on photoresist occurs after the photoresist layer 15 is formed).

Regarding claim 10, Lin et al. discloses that the partially exposing said lateral periphery of the conductive structure comprises substantially removing said layer from the substrate [col. 4, lines 36-37].

Regarding claim 11, Lin et al. discloses that the removing comprises etching said layer [col. 4, lines 37-39].

Regarding claim 13, Lin et al. discloses that said at least partially exposing said lateral periphery of the conductive structure comprises reducing said thickness of said layer (i.e. the thickness of layer 15 is reduced because it gets etched away from the top to the bottom, reducing in thickness as it is etched).

Regarding claim 14, Lin et al. discloses that reducing said thickness comprises at least partially etching said layer (e.g. col. 4, lines 35-46).

Regarding claims 15 and 16, Lin et al. discloses reducing the thickness of the layer with a shrinking agent of plasma [col. 4, lines 39-40].

Regarding claim 17, Lin et al. disclose that the at least partially exposing said lateral periphery comprises exposing said layer to a solvent [col. 4, lines 37-39].

Regarding claim 19, Lin et al. discloses that said disposing said quantity of conductive material comprises disposing solder on said layer (wherein conductive paste 30 includes "solder" per col. 2, line 32).

Regarding claim 20, Lin et al. discloses that disposing said quantity of conductive material comprises disposing conductive elastomer 30 on said layer 15.

Regarding claim 21, Lin et al. discloses that said forming said aperture comprises exposing a portion of said at least one contact pad located within a periphery thereof (i.e. pad 12 is exposed in opening 20).

Regarding claim 22, Lin et al. discloses a method of forming a solder mask (15), comprising: disposing a solder mask material comprising a polymer (15) onto an active surface of a substrate (10); forming a layer of said solder mask material having a substantially consistent thickness on the active surface of said substrate (col. 2, line 44 to col. 3, line 13), said thickness of said layer being substantially equal to a desired conductive structure height (Fig. 6 in view of col. 3, lines 2-4); and forming at least one aperture through said layer in a location corresponding to a location of at least one contact pad of said substrate to expose said at least one contact pad through said solder mask (i.e. the aperture hole 20 is over the pad 12), said solder mask material facilitating a reduction in said thickness when the conductive structure has been at least partially formed in said at least one aperture (the mask obviously "facilitates" a reduction in thickness because the layer gets thinner and thinner as it gets etched away per col. 4, lines 39-40).

Regarding claim 24, Lin et al. discloses that the disposing and said forming of said mask layer are effected substantially simultaneously (because the layer is *disposed* as spin-on "wet resist" which is *formed* as it is spun-on into a planar layer as is known for spin-on materials in the art)

Regarding claim 25, Lin et al. disclose that said forming said layer comprises planarizing said layer (because the spin-on layer 15 is made planar to have "a thickness" by spin-on per col. 2, line 61 to col. 3, line 13 and further in view of planarity depicted in the figures).

Regarding claim 31, Lin et al. discloses etching a region of said layer because the disclosed "patterning" of "photoimageable resist" is necessarily a type of "etching" (i.e. removing).

Regarding claim 32, Lin et al. discloses that the at least one solder mask material comprises a photosensitive polymeric material and wherein said forming said at least one aperture comprises exposing a region of said photosensitive polymeric material disposed over said at least one contact pad to form said at least one aperture through said layer (col. 5, top).

Regarding claim 33, Lin et al. discloses a method of exposing at least a portion of a lateral periphery of a conductive structure (i.e. "30" in Fig. 6) on a semiconductor device (in substrate 10), comprising reducing a thickness of a solder mask (15) that comprises polymeric material (photoresist) disposed around said lateral periphery (as in the resist is "reduced in thickness" by solvent or plasma to reach Fig. 7 per col. 4).

Regarding claim 34, Lin et al. discloses "plasma" as a shrinking agent (col. 4).

Regarding claim 35, Lin et al. discloses that the removal of layer 15 is selective over removal of conductive structures 30 (as seen going from Fig. 6 to Fig. 7 wherein the layer 15 is reduced in thickness, but the conductive structures are not reduced in height).

Regarding claim 36, Lin et al. discloses a method of exposing a conductive structure (30) that protrudes from a surface of a semiconductor device through a solder mask that comprises a polymeric material (15) positioned on the surface of the semiconductor device, comprising: reducing a thickness of at least portions of the solder mask laterally surrounding the conductive structures (i.e. there is a reduction in thickness exposing laterally in the transition to Fig. 7).

Regarding claim 37, all of mask 15 is reduced in thickness to be removed.

Regarding claim 38, Lin et al. discloses plasma (col. 4).

Regarding claims 39 and 40, Lin et al. discloses that the reducing comprises removing a material of the solder mask with selectivity over a material of the conductive structures (because the mask material 15 is etched away while the bumps are not etched away per Fig. 6-7).

6. Claims 1, 2, 3 and 18 are rejected under 35 U.S.C. 102(b) as being anticipated by Sherry (U.S. 4,763,829).

Regarding claim 1, Sherry discloses a method of disposing a conductive structure (15, 16, 17) on at least one contact pad on an active surface of a semiconductor device substrate (11, 12, 13), comprising: disposing a layer comprising polymeric material over the substrate (i.e. polymeric photoresist layer 14); imparting

said layer with a thickness substantially equal to a desired height of the conductive structure (Fig. 2 in view of the disclosure of the mask acting as a "mold" to form the bumps); forming at least one aperture through said layer to expose at least a portion of the at least one contact pad (holes over pads 11, 12, 13); disposing a quantity of conductive material on said layer and permitting said conductive material to substantially fill said at least one aperture [Fig. 2]; bonding said conductive material within said aperture to the at least one contact pad to form the conductive structure of substantially said desired height [the bumps 15, 16, 17 in Fig. 2 are necessarily "bonded" to the pads 11, 12, 13 since they are in electrical communication and the solder is solidified in the openings of the mask]; and at least partially exposing a lateral periphery of the conductive structure through said layer [i.e. removing polymer 14 exposes a lateral periphery of conductive structures 15, 16, 17].

Regarding claims 2, 3 and 18, Sherry discloses that the conductive material to dispose in the holes to form structures 15, 16 and 17 is "molten solder" (which is disposed by immersion in an ultrasonic solder pot depicted in Fig. 5).

7. Claims 1, 4 and 7 are rejected under 35 U.S.C. 102(b) as being anticipated by Ono (JP 6-177527).

Regarding claim 1, Ono discloses a method of disposing a conductive structure (15) on at least one contact pad (12) on an active surface of a semiconductor device substrate, comprising: disposing a mask layer comprising polymeric material 13 (since 13 can be a "peelable organic resin film" (i.e. polymer) per [0014] over the substrate; imparting said layer with a thickness substantially equal to a desired height of the

conductive structure (since mask thickness in Fig. 2b is substantially equal to the height of conductive structures 15 in Fig. 2c); forming at least one aperture through said layer to expose at least a portion of the at least one contact pad (holes over pads 12); disposing a quantity of conductive material on said layer and permitting said conductive material to substantially fill said at least one aperture [molten solder sprayed into holes]; bonding said conductive material within said aperture to the at least one contact pad to form the conductive structure of substantially said desired height [bonding necessarily occurs from Fig. 2c to 2d, in order to remove the mask and achieve electrical continuity]; and at least partially exposing a lateral periphery of the conductive structure through said layer [as seen in Fig. 2d by reducing the thickness of mask 13 on the substrate by its removal from the substrate].

Regarding claims 4 and 7, Ono discloses that the mask 13 can be an organic peelable resin film (i.e. polymer) with holes pre-cut like the prior art.

8. Claims 33, 35, 36, 39 and 40 are rejected under 35 U.S.C. 102(b) as being anticipated by Mones et al. (U.S. 4,172,907).

Regarding claim 33, Mones discloses exposing a lateral portion of a conductive structure on a semiconductor device (bump 16) comprising reducing a thickness of a solder mask [wherein "24" acts a "solder mask" per col. 3, lines 21-27) that comprises polymeric material (i.e. "resin")].

Regarding claim 35, Mones shows layer 24 selectively etched (i.e. "removed") compared to the bump 16 (as seen in Fig. 2).

Regarding claim 36, Mones discloses a method of exposing a conductive structure that protrudes from a surface of a semiconductor device (i.e. bump 16) through a solder mask that comprises a polymeric material (i.e. resin mask 24) positioned on the surface of the semiconductor device, comprising: reducing a thickness of at least portions of the solder mask laterally surrounding the conductive structures (as seen in Fig. 2 with the dotted line showing the removed material of 24 that was "reduced in thickness").

Regarding claims 39 and 40, Lin et al. discloses that the reducing comprises removing a material of the solder mask with selectivity over a material of the conductive structures (because the mechanical etching is necessarily selective to layer 24 over bump layer 16, in order to achieve the result of reducing thickness around a lateral periphery as shown in Fig. 2).

Response to Arguments

9. Applicant's arguments with respect prior art rejections have been considered but are moot in view of the new grounds of rejections.

10. Applicant's arguments with respect to the definiteness of "substantially equal" are not convincing. Applicant argues that case law dictates that one can use "substantially equal" when "one of ordinary skill in the art" knows what "substantially equal" means.

Yet, applicant does not at all quantitatively say what "substantially equal means" in this case. Applicant only says the ordinary of skill should know what it means.

The examiner looks to the definition of "substantially" and sees that the "majority" of something is the "substantiality" of it.

Therefore, the height of conductive structures is considered as being "substantially equal" to the thickness of the mask layer when the structure height is more than 50% and less than 150% of the thickness of the mask.

Conclusion

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Evan Pert whose telephone number is 703-306-5689. The examiner can normally be reached on M-F (7:30AM-3:30 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kammie Cuneo can be reached on 703-308-1233. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 308-0956.

ETP
September 2, 2003


EVAN PERT
PRIMARY EXAMINER